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What is claimed is:

1. An optical information recording apparatus for recording
5 information in an optical information recording medium having an
information recording layer in which information is recorded
utilizing holography, the apparatus comprising:
- information light generation means for generating
information light carrying information;
- 10 recording reference light generation means including phase
modulation means for spatially modulating the phase of light, for
generating reference light for recording having a phase spatially
modulated by the phase modulation means; and
- a recording optical system for illuminating the information
15 recording layer on the same side thereof with the information light
generated by the information light generation means and the
reference light for recording generated by the recording
reference light generation means such that the information is
20 recorded in the information recording layer in the form of an
interference pattern as a result of interference between the
information light and the reference light for recording.
2. An optical information recording apparatus according to
claim 1, wherein the optical information recording medium has a
positioning region for recording information for positioning the
25 information light and the reference light for recording, the
apparatus further comprising position control means for

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$\frac{d}{dt} \left(\frac{\partial L}{\partial \dot{x}} \right) = \frac{\partial L}{\partial x}$

10 4. An optical information recording apparatus according
to claim 1, wherein the information light generation means
generates the information light in a plurality of wavelength bands,
and the recording reference light generation means generates the
reference light for recording in the same plurality of wavelength
15 bands as those of the information light.

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25 generating information light carrying information;
spatially modulating the phase of light to generate

reference light for recording having a spatially modulated phase;
and

illuminating the information recording layer on the same
side thereof with the information light and the reference light
5 for recording to record the information in the information
recording layer in the form of an interference pattern as a result
of interference between the information light and the reference
light for recording.

7. An optical information reproducing apparatus for
10 reproducing information utilizing holography from an optical
information recording medium having an information recording
layer in which the information is recorded in the form of an
interference pattern as a result of interference between
information light carrying the information and reference light
15 for recording having a spatially modulated phase, the apparatus
comprising:

reproduction reference light generation means including
phase modulation means for spatially modulating the phase of light,
for generating reference light for reproduction having a phase
20 spatially modulated by the phase modulation means;

a reproducing optical system for illuminating the
information recording layer with the reference light for
reproduction generated by the reproduction reference light
generation means and for collecting reproduction light generated
25 at the information recording layer when illuminated with the
reference light for reproduction on the same side of the

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information recording layer that is illuminated with the reference light for reproduction; and

detection means for detecting the reproduction light collected by the reproducing optical system.

5 8. An optical information reproducing apparatus according to claim 7, wherein the optical information recording medium has a positioning region for recording information for positioning the reference light for reproduction, the apparatus further comprising position control means for controlling the position
10 of the reference light for reproduction relative to the optical information recording medium using the information recorded in the positioning region.

9. An optical information reproducing apparatus according to claim 7, wherein the reproducing optical system projects the
15 reference light for reproduction and collects the reproduction light such that the optical axis of the reference light for reproduction and the optical axis of the reproduction light are located on the same line.

10. An optical information reproducing apparatus according to claim 7, wherein the reproduction reference light generation
20 means generates the reference light for reproduction in a plurality of wavelength bands, and the detection means detects the reproduction light in the same plurality of wavelength bands.

11. An optical information reproducing method for
25 reproducing information utilizing holography from an optical information recording medium having an information recording

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5 comprising the steps of:

10 illuminating the information recording layer with the reference light for reproduction and collecting reproduction light generated at the information recording layer when illuminated with the reference light for reproduction on the same side of the information recording layer that is illuminated with the reference light for reproduction; and

15 detecting the collected reproduction light.

20 position of a wavelength of incident light and in which information
is recorded utilizing holography, the apparatus comprising:

wavelength selection means for selecting a wavelength of light illuminating the information recording layer from among a plurality of wavelengths;

25 information light generation means for generating
 information light having the wavelength selected by the

wavelength selection means and carrying information;

recording reference light generation means for generating reference light for recording having the wavelength selected by the wavelength selection means; and

5 a recording optical system for illuminating the information recording layer on the same side thereof with the information light generated by the information light generation means and the reference light for recording generated by the recording reference light generation means such that the
10 information is recorded in the information recording layer in the form of an interference pattern as a result of interference between the information light and the reference light for recording.

13. An optical information recording apparatus according to claim 12, wherein the optical information recording medium has
15 a positioning region for recording information for positioning the information light and the reference light for recording, the apparatus further comprising position control means for controlling the positions of the information light and the reference light for recording relative to the optical information
20 recording medium using the information recorded in the positioning region.

14. An optical information recording apparatus according to claim 12, wherein the recording optical system projects the information light and the reference light for recording such that
25 the optical axis of the information light and the optical axis of the reference light for recording are located on the same line.

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wavelength selection means for selecting a wavelength of light illuminating the information recording layer from among a plurality of wavelengths;

reproduction reference light generation means for
generating reference light for reproduction having the wavelength
selected by the wavelength selection means;

a reproducing optical system for illuminating the information recording layer with the reference light for reproduction generated by the reproduction reference light generation means and for collecting reproduction light generated at the information recording layer when illuminated with the reference light for reproduction on the same side of the information recording layer that is illuminated with the reference light for reproduction; and

detection means for detecting the reproduction light collected by the reproducing optical system.

17. An optical information reproducing apparatus according to claim 16, wherein the optical information recording medium has a positioning region for recording information for positioning the reference light for reproduction, the apparatus further comprising position control means for controlling the position of the reference light for reproduction relative to the optical information recording medium using the information recorded in the positioning region.

18. An optical information reproducing apparatus according to claim 16, wherein the reproducing optical system projects the reference light for reproduction and collects the reproduction light such that the optical axis of the reference light for reproduction and the optical axis of the reproduction light are located on the same line.

19. An optical information reproducing method for reproducing information utilizing holography from an optical information recording medium having an information recording layer in which the information is recorded in the form of an interference pattern as a result of interference between information light having a wavelength selected from among a plurality of wavelengths and carrying the information and reference light for recording having the wavelength selected from among a plurality of wavelengths, the method comprising the steps of:

selecting a wavelength of light illuminating the information recording layer from among a plurality of wavelengths;

generating reference light for reproduction having the selected wavelength;

illuminating the information recording layer with the reference light for reproduction and collecting reproduction light generated at the information recording layer when illuminated with the reference light for reproduction on the same side of the information recording layer that is illuminated with

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the reference light for reproduction; and

detecting the collected reproduction light.

20. An optical information recording apparatus for recording information in an optical information recording medium
 5 having an information recording layer in which a change in absorbance occurs in an absorption spectrum thereof in the position of a wavelength of incident light and in which information is recorded utilizing holography, the apparatus comprising:

10 wavelength selection means for selecting a wavelength of light illuminating the information recording layer from among a plurality of wavelengths;

information light generation means for generating information light having the wavelength selected by the wavelength selection means and carrying information;

15 recording reference light generation means including phase modulation means for spatially modulating the phase of light, for generating reference light for recording having the wavelength selected by the wavelength selection means and having a phase spatially modulated by the phase modulation means; and

20 a recording optical system for illuminating the information recording layer on the same side thereof with the information light generated by the information light generation means and the reference light for recording generated by the recording reference light generation means such that the
 25 information is recorded in the information recording layer in the form of an interference pattern as a result of interference between

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21. An optical information recording apparatus according to claim 20, wherein the optical information recording medium has a positioning region for recording information for positioning the information light and the reference light for recording, the apparatus further comprising position control means for controlling the positions of the information light and the reference light for recording relative to the optical information recording medium using the information recorded in the positioning region.

22. An optical information recording apparatus according to claim 20, wherein the recording optical system projects the information light and the reference light for recording such that the optical axis of the information light and the optical axis of the reference light for recording are located on the same line.

23. An optical information recording method for recording information in an optical information recording medium having an information recording layer in which a change in absorbance occurs in an absorption spectrum thereof in the position of a wavelength of incident light and in which information is recorded utilizing holography, the method comprising the steps of:

selecting a wavelength of light illuminating the
information recording layer from among a plurality of
wavelengths;

25 generating information light having the selected
wavelength and carrying information;

spatially modulating the phase of light to generate
reference light for recording having the selected wavelength and
a spatially modulated phase; and

5 illuminating the information recording layer on the same
side thereof with the information light and the reference light
for recording to record the information in the information
recording layer in the form of an interference pattern as a result
of interference between the information light and the reference
light for recording.

10 24. An optical information reproducing apparatus for
reproducing information utilizing holography from an optical
information recording medium having an information recording
layer in which the information is recorded in the form of an
interference pattern as a result of interference between
15 information light having a wavelength selected from among a
plurality of wavelengths and carrying the information and
reference light for recording having the wavelength selected from
among a plurality of wavelengths and having a spatially modulated
phase, the apparatus comprising:

20 wavelength selection means for selecting a wavelength of
light illuminating the information recording layer from among a
plurality of wavelengths;

reproduction reference light generation means including
phase modulation means for spatially modulating the phase of light,
25 for generating reference light for reproduction having the
wavelength selected by the wavelength selection means and having

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a phase spatially modulated by the phase modulation means;

5 a reproducing optical system for illuminating the information recording layer with the reference light for reproduction generated by the reproduction reference light generation means and for collecting reproduction light generated at the information recording layer when illuminated with the reference light for reproduction on the same side of the information recording layer that is illuminated with the reference light for reproduction; and

10 detection means for detecting the reproduction light collected by the reproducing optical system.

25. An optical information reproducing apparatus according to claim 24, wherein the optical information recording medium has a positioning region for recording information for positioning the reference light for reproduction, the apparatus further comprising position control means for controlling the position of the reference light for reproduction relative to the optical information recording medium using the information recorded in the positioning region.

20 26. An optical information reproducing apparatus according to claim 24, wherein the reproducing optical system projects the reference light for reproduction and collects the reproduction light such that the optical axis of the reference light for reproduction and the optical axis of the reproduction light are
25 located on the same line.

27. An optical information reproducing method for

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reproducing information utilizing holography from an optical information recording medium having an information recording layer in which the information is recorded in the form of an interference pattern as a result of interference between
 5 information light having a wavelength selected from among a plurality of wavelengths and carrying the information and reference light for recording having the wavelength selected from among a plurality of wavelengths and having a spatially modulated phase, the method comprising the steps of:

10 selecting a wavelength of light illuminating the information recording layer from among a plurality of wavelengths;

spatially modulating the phase of light to generate reference light for reproduction having the selected wavelength
 15 and a spatially modulated phase;

 illuminating the information recording layer with the reference light for reproduction and collecting reproduction light generated at the information recording layer when
 20 illuminated with the reference light for reproduction on the same side of the information recording layer that is illuminated with the reference light for reproduction; and

detecting the collected reproduction light.

28. An optical information recording apparatus for recording information in an optical information recording medium
 25 having an information recording layer in which information is recorded utilizing holography, the apparatus comprising:

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a pick-up device provided in a face-to-face relationship with the optical information recording medium, the pick-up device having:

a light source for emitting beams of light;

5 information light generation means for spatially modulating the beams of light emitted by the light source to generate information light carrying information;

recording reference light generation means for generating reference light for recording using the beams of light emitted
10 by the light source; and

a recording optical system for illuminating the information recording layer on the same side thereof with the information light generated by the information light generation means and the reference light for recording generated by the recording
15 reference light generation means such that the information is recorded in the information recording layer in the form of an interference pattern as a result of interference between the information light and the reference light for recording.

29. An optical information recording apparatus according to
20 claim 28, wherein the recording optical system projects the information light and the reference light for recording such that the optical axis of the information light and the optical axis of the reference light for recording are located on the same line.

30. An optical information recording apparatus according
25 to claim 28, wherein the light source emits the beams of light in a plurality of wavelength bands.

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37. An optical information recording apparatus according
15 to claim 28, comprising a plurality of the pick-up devices.

reproduction reference light generation means for
25 generating reference light for reproduction using the beams of
light emitted by the light source;

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a reproducing optical system for illuminating the information recording layer with the reference light for reproduction generated by the reproduction reference light generation means and for collecting reproduction light generated at the information recording layer when illuminated with the reference light for reproduction on the same side of the information recording layer that is illuminated with the reference light for reproduction; and

detection means for detecting the reproduction light collected by the reproducing optical system.

39. An optical information reproducing apparatus according to claim 38, wherein the reproducing optical system projects the reference light for reproduction and collects the reproduction light such that the axis of the reference light for reproduction and the axis of the reproduction light are located on the same line.

40. An optical information reproducing apparatus according to claim 38, wherein the light source emits the beams of light in a plurality of wavelength bands, and the detection means detects the reproduction light in the same plurality of wavelength bands as those of the beams of light emitted by the light source.

41. An optical information reproducing apparatus according to claim 38, wherein the pick-up device has light quantity monitoring means for monitoring the quantity of the reference light for reproduction.

42. An optical information reproducing apparatus according

form of an interference pattern as a result of interference between information light and reference light for recording utilizing holography and for generating reproduction light associated with the recorded information when illuminated with reference light for reproduction; and

5 a second information layer which is provided in a position different from the position of the first information layer in the direction of the thickness and in which information is recorded using means different from that for the recording of information
10 in the first information layer.

47. An optical information recording medium according to claim 46, wherein information for positioning the information light, the reference light for recording and the reference light for reproduction is recorded in the second information layer.

15 48. An optical information recording medium according to claim 46, wherein a gap having a predetermined thickness is formed between the first and second information layers.

49. An optical information recording medium according to claim 48, further comprising a spacer for separating the first
20 and second information layers with a predetermined interval between them to form the gap.

50. An optical information recording medium according to claim 48, further comprising a transparent substrate provided
between the first and second information layers to form the gap.

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